

Statement of the Claims

1. (presently amended) An optical apparatus for investigating a fluid stream, comprising:
an optical ~~fiber~~ probe having a distal end and a longitudinal axis, said distal end of said optical ~~fiber~~ probe comprises a substantially cubical corner defined by three planes substantially perpendicular to each other and not parallel to a plane including said longitudinal axis.

2. (presently amended) An optical apparatus according to claim 1, wherein:
a diagonal of said cubical corner is aligned with a longitudinal axis of said optical ~~fiber~~ probe.

3. (original) An optical apparatus according to claim 1, wherein:
an incident angle of light at each of said three planes is $54.73^\circ \pm 1^\circ$.

4. (original) An optical apparatus according to claim 1, wherein:
said optical fiber terminates at a sharp tip where said three planes meet.

5. (presently amended) An optical apparatus according to claim 1, wherein:
said optical probe ~~fiber~~ terminates at a rounded corner.

6. (presently amended) An optical apparatus according to claim 5, wherein:
said three planes define three lines where respective sets of two of said three planes meet, and said optical probe ~~fiber~~ is rounded at each of said three lines.

7. (presently amended) An optical apparatus according to claim 1, wherein:

said optical probe fiber has a base adjacent cubical corner, said base tapering in diameter from a larger to a smaller diameter as said probe fiber extends distally towards said cubical corner.

8. (original) An optical apparatus according to claim 7, wherein:

said taper is less than 10°.

9. (original) An optical apparatus according to claim 7, wherein:

said taper is at most 5°.

10. (presently amended) An optical apparatus according to claim 1, wherein:

said optical probe fiber has a diameter of between 0.2 mm and 0.4 mm.

11. (presently amended) An optical apparatus for investigating a fluid stream, comprising:

an optical probe fiber having a distal end, said distal end of said optical probe fiber comprises a substantially uniform cone having a face angled at $45^\circ \pm 2^\circ$ relative to a longitudinal axis.

12. (presently amended) An optical apparatus according to claim 11, wherein:

said optical ~~fiber~~ probe terminates at a sharp tip.

13. (presently amended) An optical apparatus according to claim 11, wherein:

said optical probe fiber terminates at a rounded tip portion, said rounded tip having a diameter at most twenty-five percent of a width of said optical probe fiber at a base adjacent said cone.

14. (presently amended) An optical apparatus according to claim 11, wherein:

said optical probe fiber has a base adjacent said cone, said base tapering in diameter from a larger to a smaller diameter as said probe fiber extends distally towards said cone.

15. (original) An optical apparatus according to claim 14, wherein:

said taper is less than 10° .

16. (original) An optical apparatus according to claim 14, wherein:

said taper is at most 5° .

17. (presently amended) An optical apparatus according to claim 11, wherein:

said optical probe fiber has a diameter of between 0.2 mm and 0.4 mm.

18. (presently amended) An optical apparatus for investigating a fluid stream, comprising:

an optical ~~fiber~~ probe having a distal end, said distal end of said optical probe ~~fiber~~ comprises either a paraboloid or a hemisphere. ~~portion of a sphere.~~

19. (presently amended) An optical apparatus according to claim 18, wherein:

said distal end of said optical probe ~~fiber~~ comprises a hemisphere.

20. (presently amended) An optical apparatus according to claim 18, wherein:

said optical probe ~~fiber~~ has a base adjacent said paraboloid or hemisphere, said base tapering in diameter from a larger to a smaller diameter as said probe ~~fiber~~ extends distally towards said paraboloid or hemisphere.

21. (original) An optical apparatus according to claim 20, wherein:

said taper is less than 10°.

22. (presently amended) An optical well logging apparatus for investigating a fluid stream flowing in a well, comprising:

a tool suspended in the well, said tool including an optical probe ~~fiber~~ having a distal end, said distal end of said optical probe ~~fiber~~ having a ~~an~~ numerical aperture of less than 0.3.

23. (presently amended) An optical apparatus for investigating a fluid stream, comprising:

- a) a tool having an elongate body suspended in the well;
- b) a light source; and
- c) a plurality of optical probes coupled to said elongate body and to said light source, said plurality of optical probes including at least one probe comprising an optical fiber having a longitudinal axis and a distal end arranged as either
 - (i) a substantially cubical corner defined by three planes substantially perpendicular to each other and not parallel to a plane including said longitudinal axis,
 - (ii) a paraboloid; or
 - (iii) ~~a portion of~~ a hemisphere.

24. (presently amended) An optical apparatus according to claim 23, wherein:

said plurality of optical probes includes a first probe comprising an optical fiber having a distal end arranged as either a substantially cubical corner defined by three planes substantially perpendicular to each other and not parallel to a plane including said longitudinal axis, or a substantially uniform cone having a face angled at $45^\circ \pm 2^\circ$ relative to a longitudinal axis, and a second probe comprising an optical fiber having a distal end arranged as a paraboloid or a ~~portion of a~~ hemisphere.

25. (presently amended) An optical well logging apparatus for investigating a fluid stream flowing in a well, comprising:

- a) a tool having an elongate body suspended in the well;
- b) a light source; and
- c) a plurality of optical probes coupled to said elongate body and to said light source, said plurality of optical probes including a first probe comprising an optical fiber having a distal end arranged to provide a numerical aperture of below 0.3 and a second probe comprising an optical fiber having a distal end arranged to provide a numerical aperture of above 0.8.